

RESEARCH

Eastern Utilization Laboratory Carries on Vigorous Program to Develop wider use of Potatoes

By Norman E. Roberts and
Robert H. Treadway

Because potatoes are one of the nation's foremost agricultural products, and because the value of the potato crop is in constant danger of dropping to a ruinously low level as a result of even small surpluses, the U. S. Department of Agriculture is engaged in a vigorous program of utilization research on this commodity. The studies range from fundamental research on the chemical constituents of potatoes all the way to the development of new potato products and technological advances in the field of potato processing.

IN TWO LOCATIONS

Utilization research on potatoes by the Department of Agriculture is carried on in two widely separated locations. In Wyndmoor, Pa. (near Philadelphia), the Eastern Utilization Research and Development Division has been doing research on the nitrogen constituents of potatoes, with special reference to the amino acids: on citric and other acids of potatoes which appear to be concerned with the browning of chips and French fries; and on the fat in potatoes which causes processed products to spoil in storage.

Out in Albany, Calif. (near San Francisco), the Western Utilization Research and Development Division is interested in the sugars in potatoes, potato enzymes, and in the potato consultants that make up the cell wall and thus contribute to the texture of

which lower their consumer acceptability, and which may also lower their food value. Before we can determine exactly what the changes that occur are, and how they can be avoided, we must study the raw, stored, and processed potato and be able to express in quantitative terms which components have been affected and to what extent. Once these things are known, intelligent preventive steps can be taken.

DARK CHIPS PROBLEM

To illustrate, let's take a problem which has been vexing the potato-chip industry for years, the lower their food value. Before we can determine exactly what the changes that occur are, and how they can be avoided, we must study the raw, stored, and processed potato and be able to express in quantitative terms which components have been affected and to what extent. Once these things are known, intelligent preventive steps can be taken.

work is based on the observation that free amino acids react with sugars, glucose and fructose, and sugars under the conditions of chip frying to produce brown pigments that may well be the cause of the dark color that develops in chips.

To find out whether this is the case, and if so, which amino acids and which sugars do the reacting, these scientists designed a large series of experiments using paper discs in place of potato slices. They impregnated these discs with various amino acids and sugars, and fried them for two minutes in deep fat at 370°F.

After frying, the discs were examined with a spectro-photometer to determine the exact amount of browning that had taken place.

20 ACIDS TESTED

This work was done with 20 different amino acids known to be present in potatoes. These were tested in various combinations of

AFTER COOK DISCOLORATION

Another problem that has been given attention at the Eastern Division is the tendency of certain potatoes, which may look quite normal in the raw state, to show a gray discoloration when cooked. For more than 20 years, this after-cooking discoloration has been prevalent in many potatoes grown east of the Mississippi River. A strange characteristic of it is that it invariably occurs at the stem end of the potato.

What is there in this particular



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able contributions to the technology of processing. The work done here on dehydrated mashed-potato granules has significantly improved the quality of this product.

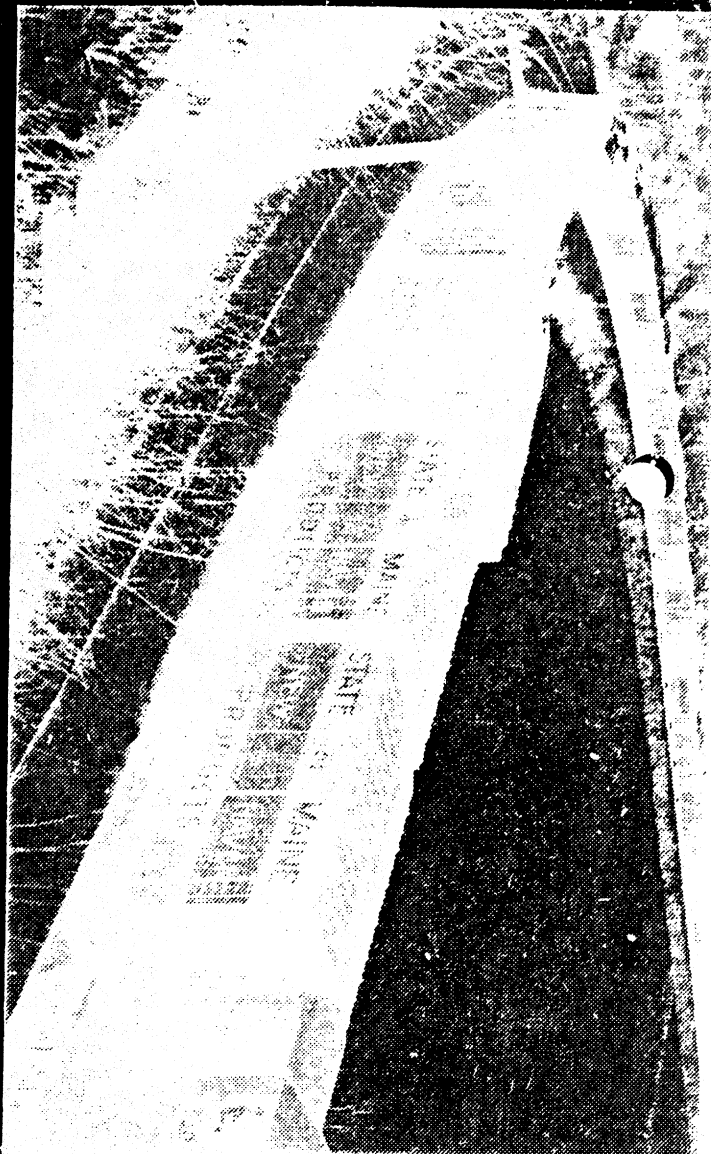
IMPORTANT RESULTS

This article is primarily concerned with the research of the Eastern Division. Some extremely important results from a fundamental standpoint are emerging from the Division's study of the nitrogen constituents of potatoes. For years potatoes have not been given the well-rounded study they deserve because they have been thought of as not much more than a combination of starch and water.

It is true, of course that $\frac{2}{3}$ to $\frac{3}{4}$ of the dry weight of a potato is starch, but tucked away in the other $\frac{1}{4}$ to $\frac{1}{3}$, Nature has provided important vitamins, minerals, and amino acids. It was shown 30 years ago that the human body could be kept in nitrogen balance and in good health for as long as five months on a diet of potatoes and a small amount of fat.

About 1/10 of the solids of potatoes consist of nitrogen compounds. These are both protein and nonprotein compounds, the non-protein consisting largely of amino acids. These amino acids are the building blocks of proteins. From a nutritional standpoint they are exceedingly important to health, and eight of them are considered essential to the human diet.

Scientists of the Eastern Division have identified 23 amino acids in potatoes, including all eight of the essential amino acids. These findings are important nutritional information, but this is not the basic purpose for which they are being gathered. We know that certain things happen to potatoes in storage and in processing



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discoloration? The answer to this question is that effective action, if coupled with effective action, can control the situation. It means a tremendous saving, not only to homemakers and restaurants, but also to potato processors to whom it represents a serious loss, especially in canned potatoes, and frozen and dehydrated potato products. It has been found that water blanching and acid dipping are of limited value in preventing after-cooking

discoloration. Sulfiting is some- what effective, but cannot be used in potato products containing meat.

CONTRADICTION THEORIES

Many scientists have wrestled with this problem over the years, and have come up with a bewildering and contradictory collection of theories. None of them has been conclusively proved.

One theory that has been explored further at the Eastern Division is that certain compounds in potatoes that chemists call polyphenols, notable chlorogenic acid, oxidize when the potato is cooked to form a dark pigment, and that this oxidation may be catalyzed by the iron in the potato.

With this as a lead, Eastern Division scientists set out to study the polyphenolic compounds of potatoes (stem end, bud end, and whole potato) or from the whole potato

chromatography, which in recent years has become one of the analytical tools. This process, elegant for both its simplicity and its accuracy, consists of placing near the edge of a special sheet of paper a small drop of the substance to be analyzed, in this case the concentrated extract from various parts of the potato (stem end, bud end, and whole potato) or from the whole potato

The sheet is suspended under certain conditions for several hours, while the substance is allowed to proceed along the sheet by capillary. Various components of the compound will travel different distances, so that at the end of the period there will appear on the sheet a series of spots which will be visible in ultraviolet light.

CHIP-BAY

The potato-chip bar is another development of the Eastern Division. By crushing chips and molding them into bars by pressure, a product is made which can be shipped economically without the elaborate protective packaging normally required for potato chips. At the same time, the flavor and crunchy texture of the original chips are retained in the bars, and the possibilities for commercialization of this product are being explored. The Eastern Division has also experimented with potato-chip candy products.

Until a few years ago, granules appeared to be the most practical form in which to prepare dehydrated mashed potatoes. With improvements over the years, granules have become quite popular. Some work was done on granules at the Eastern Division along the lines of dehydration with solvents such as alcohol instead of heat, with the purpose of better flavor retention. Processes for solvent dehydration were worked out on a laboratory scale, but have not been commercialized.

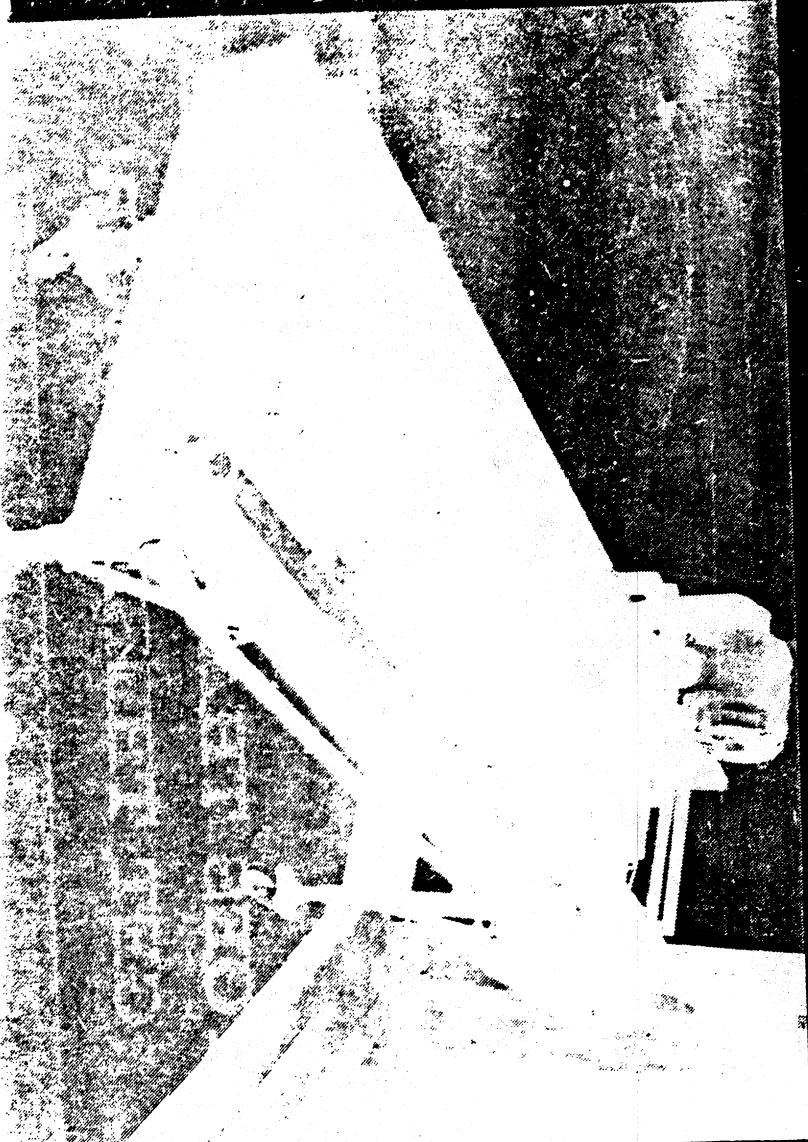
STARTED FOUR YEARS AGO

About the time this work on granules was being done, engineers at the Eastern Division became interested in the quick dehydration of potatoes on drum dryers such as those used in making potato flour. Efforts to make dehydrated potatoes by such a method had been made before, but the engineers

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sound. And so they started, about four years ago, to develop the product that is now on the verge of full commercialization, potato flakes.

The process for making potato flakes, as developed at the Eastern Division, consists of preparing mashed potatoes by a two-step cooking, first for 15 to 30 minutes at a temperature well below boiling, then at the boiling temperature until they can be mashed without excessive cell damage. This first low temperature cooking has been found to be the secret of making good flakes from a wide variety of potatoes within a considerable range of solids content. The mashed potatoes are then applied to a revolving heated drum on which they are dried to about four percent moisture in a matter of seconds. The potatoes come from the drum in the form of parchment-like sheets which are then put into flakes and packaged.

EASILY RECONSTITUTED

Potato flakes are easily reconstituted into mashed potatoes by the addition of boiling water, milk, and butter. The flavor and texture of reconstituted flakes are excellent, and flakes have been acclaimed as the equal of fresh mashed potatoes in many consumer tests. Potato flakes enjoyed a brisk sale in a marketing test conducted last year in the Binghamton-Erdcote-Johnson City area of New York. In this test the entire supply of almost 900 cases of flakes were sold in five weeks, and six out of ten of the initial buyers made repeat purchases; nine out of ten said they would continue to buy flakes if they were available. Reports of the building of plants for potato flake production have appeared in the Potato Council's and other pieces and need not be repeated here. Potato flakes should be of